NCDENR

North Carolina Department of Environment and Natural Resources
Division of Pollution Prevention and Environmental Assistance

Plastics Density

This lesson was created in part by the Pisgah Forest Institute and Wake County.

Objective

Investigate how different numbered plastics have different properties.

Materials

- Pieces of cut up plastic number 1-7
- Container of water for each student group
- Aluminum foil
- #1 plastic soda bottle with cap
- Salt
- Hot tap water and 4 thermometers
- #6 expanded Styrofoam coffee cup; #1 plastic drink bottle; paper cup; #6 non-expanded plastic picnic-style disposable cup
- Optional - pieces of fabric (fur, flannel, silk, cotton, synthetic fabrics)

Summary

Plastic is a versatile product. Plastic can be flexible or rigid; transparent or opaque. It can look like leather, wood, or silk. It can be made into toys or heart valves. Altogether there are more than 10,000 different kinds of plastics. The basic raw materials for plastic are petroleum and/or natural gas. These fossil fuels are sometimes combined with other elements, such as oxygen or chlorine, to make difference types of plastic.

Pro: Plastics are really very energy efficient. It takes 20-40 percent less energy to manufacture plastic grocery bags than paper ones. And, since plastics are lightweight and take up so little space, it is much more efficient to transport them. It takes seven trucks to deliver the same number of papers bags as can be carried in one truckload of plastic bags.

Con: Plastic bags are a pervasive problem for municipalities looking to control litter because they are prone to catching the wind and floating to where they are not easily retrieved. Also, plastic is a petroleum based product which is a non-renewable resource that we generally purchase from overseas markets.

Using some common objects found in the classroom and a clear container filled with water, demonstrate that some objects sink and some float. Those that have a greater density than water will sink and those that have less density than water will float. Plastics also behave the same way.

1639 Mail Service Center, Raleigh, North Carolina 27699-1639
Phone: (919) 715-6507 FAX: (919) 715-6794

Density Procedure

1. Cut up different types of plastic products.
2. Explain to students that some of these plastics will sink and some will float.
3. Have students predict which pieces will sink and which will float. Allow students to examine the plastic in small groups.
4. Put all plastic pieces in the water and record observations.
    a. #1: sinks
    b. #2: floats
    c. #3: sinks
    d. #4: floats
    e. #5: floats
    f. #6: sinks if condensed/non-expanded (picnic cups, etc); floats if "expanded" (polystyrene coffee cups, etc)
    g. #7; some will sink and some will float since it is an unpredictable mixture of plastics

Leading Question

1. Discuss with students how the shape of an item can affect its ability to float or sink. Demonstrate with an empty soda bottle with the cap on. Why does it float? Now take the cap off and fill it with water? Why does it sink?
2. Have students use pieces of aluminum foil and make "boats" that will float.
3. Discuss why floating litter would be a problem for aquatic animals.
4. How would the plastics behave if the water was very salty (like the ocean)? To test this, add several heaping tablespoons to the water and stir well. Retest plastics.

Heating and Cooling Procedure

1. Explain to students that when heat is applied to a substance, they can change its state. For example, when heat is applied to ice (a solid), it will melt into liquid water and will remain a liquid at room temperature. When wax is heated by the wick of a candle, it melts from a solid to a liquid. However, when it is allowed to cool at room temperature, it returns to a solid.
2. Plastics behave more like wax when heated. To demonstrate this, pour hot water (as hot as your tap allows) into a #1 clean, empty, drink bottle. Fill ¾ full and cap. Using gloves, demonstrate to the students that the bottle becomes more flexible when it is heated by gently squeezing the side of the bottle.
3. Note that the plastic used in the above step was a number 1 plastic bottle.
4. Repeat the same experiment using a plastic milk jug or shampoo bottle, a #2 plastic. Allow students to predict the results. The milk jug will not become as malleable when hot water is added.
5. Continue this line of thinking by arranging four containers for the students: a Styrofoam (#6 expanded) coffee cup, a #1 plastic drink bottle, a paper cup, and a #6 non-expanded plastic picnic-style disposable cup.
6. Using hot tap water, fill each container with 50 mL of water. Immediately put a thermometer in each container and record the temperature.

Leading Question

1. Have students predict which container will be the best insulator after 15 minutes. During the 15 minute wait time, discuss with students the transfer of energy that occurs when something cools.
2. Discuss with students how to increase the insulation value of different plastics. They could wrap material around each one (fur, flannel, silk, cotton, synthetic fabrics) and

retest results. Also, they could stack the cups in different ways to increase heat retention. Retest ideas if desired.

Plastic Type	Name	Properties	Density Range	Common Uses	Recycled Into
PET	Polyethylene terephthalate	Tough, rigid shatter-resistant, softens if heated	1.38-1.39 g/mL	Soda, water and juice bottles. Some ThermaForms (takeout and produce container).	*Fiberfill for winter coats, sleeping bags and bean bags. Rope, *carpet, parking stops and other plastic bottles.
HDPE	High Density Polyethylene	Semi-rigid, tough, flexible	0.95-0.97 g/mL	Milk and water jugs. Detergent bottles. Margarine tubs. Thinner bags (grocery sack).	*Toys, *piping, plastic lumber, *nursery containers and other plastic bottles.
Vinyl	Polyvinyl Chloride	Strong, semi-rigid, glossy	1.16-1.35 g/mL	Siding and pipes. Shower curtains. Some detergent bottles. Some shrink wrap.	Plastic pipes, shower curtains, medical tubing, and vinyl dashboards.
LDPE	Low Density Polyethylene	Flexible, not crinkly, moisture-proof	0.92-0.94 g/mL	Thicker bags (Garbage, sandwich and dry cleaning). Plastic wrap. 6-pack rings.	Plastic lumber, wrapping films, grocery/sandwich bags and *recycling carts.
PP	Polypropylene	Non-glossy, semi-rigid	.91 0.90-0.~~0~~1 g/mL	Yogurt cups and margarine tubs. Screw-on lids/caps. Straws.	*Clothes hangers. Car bumpers.
PS	Polystyrene	Brittle, sometimes glossy, strong chemical reactions	1.05-1.07 g/mL	Expanded Styrofoam egg cartons, packing pellets and take-out containers. Non expanded plastic picnic cups and cutlery.	Baseboards, *CD cases, lightweight concrete and packaging.
Number 7 plastics	Other	Varies	Varies	Plastics mixture - squeezable bottles, biodegradable plastics and Tupperware.	Difficult to recycle

Items with an * are manufactured in NC.